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The Responsiveness of Rice Area to Price and Production Costs in Jambi

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Abstract: Ordinary least squares and seemingly unrelated regression procedures were used to analyze the impacts of changes in rice prices and production costs on Jambi rice planted area. Regional response models were estimated over the 1986-2013 period. Supply-inducing prices of rice were estimated as a function of effective rice support prices and average market prices. Expected production costs per hectare were estimated using lagged actual total variable cash production expenses per hectare. Estimated short-run price and production cost elasticity were found to be inelastic at the regional level. However, the magnitudes of the production cost elasticity were found to be greater than the price elasticity. Estimated long-run elasticity at the Jambi level was inelastic for changes in price but elastic for changes in production costs. Although area response varied across regions, similar relationships were found between price and production cost elasticity.

Keywords: Responsiveness; rice area; price and production costs

1. Introduction

In a mixed economy such as Indonesia's, rice prices are formed in markets and reflect a combination of government interventions and basic market forces. Rice prices have nearly always been heavily influenced by direct policy interventions, and hence the acreage response decision. The government can also affect the basic market forces that influence commodity price information (Edison, 2013).

Rice area in Jambi has varied considerably over the past two decades in response to a variety of factors (Anonymous, 2014). Farm policy analyses for rice, as well as for other crops, has devoted much attention toward investigations of the impacts of changes in the level of support prices on the marketing prices and on the resulting production decisions and financial positions of producers (Choi, and Helmerger, 1993; Mamingi, 1997; Keeney and Hertel, 2008). Little attention, however, has been given to the impact of changes in production costs. The level of rice production costs has become an increasingly important factor in producers' planting decisions over the past several years (Dawe, 2010; Basorun and Fasakin, 2012).

Knowledge of the impact of changes in production costs on the planting decisions of producers becomes increasingly important as we enter an era of farm policy debate in which environmental and budgetary issues will likely have greater impacts on the formation of farm program provisions (Lee, and Helmberger, 1985; Shaikh, and Shah, 2008; Edison 2011). Actions such as restricting the use of certain chemicals and pesticides, requiring specific land conservation measures to protect the environment, or instituting some type of user fee to reduce the budget deficit (Mundlak, 2008).

This study analyzes the relative impacts of changes in price and production costs on Jambi planted rice area over the past three decades. A theoretical framework underlying the foundation of the area response of rice to change in price, production costs, and other factors is presented, followed by the specification of a response model (Guyomard *et al*., 1996). This model is then estimated at the regional level. Model estimation results along with short-run and long run elasticity measures for both price and production costs are presented and discussed.

2. Materials and Methods

2.1 Model Specification

A simplified area response function might be represented by the expression of (Chavas, and Hold, 1990)

$$A = f(P, X) \quad (1)$$

where A is the planted area of the commodity, P is the price of the commodity, and X is a vector of variables representing supply shifters. Under condition in which no intervention into the market is made by government for purposes of supporting prices or controlling production, P would represent the market price of the commodity and A would represent the unconstrained area of the commodity planted in response to given levels of P and X.

By incorporating these variable definitions into the area response function of equation (1), the general response model estimated in this study may be specified as

$$A_t = \alpha_0 + \alpha_1 PS_t + \alpha_2 A_{t-1} + \alpha_3 ECOP_t + \alpha_4 T + \varepsilon_t \quad (2)$$

where A_t is current year planted rice area (in hectare) in year t, PS_t is the supply-inducing price of rice (in rupiah) in year t, A_{t-1} is lagged planted rice area in year t-1, $ECOP_t$ is the expected variable cash production costs per hectare for rice in year t, and T is a trend variable.

2.2 Data and Model Estimation

This response model was estimated over the time period from 1986 to 2013 at the regional level. Rice production regions were defined to be consistent with those regions for which BPS (Central Bureau of Statistics) publishes annual estimates of rice production costs (BPS, 2014). Annual rice planted area data were obtained from various issues of BPS reports. Supply-inducing prices of rice were estimated using average market prices obtained from BPS reports. Rice farm program provision such as area allotments programs were obtained from BPS reports and other various statistical reports. Time series estimates of rice variable production expenses per hectare for the year 1986-2013 were taken from Department of Agriculture Jambi Province. All price and cost data were deflated using this same index.

3. Results and Discussion

Results from ordinary least squares (OLS) estimation of Jambi area response model are presented in Table 1. All explanatory variables included in the model had the correct signs and were found to be statistically significant at the 5-percent level. Two tests were conducted to check for the presence of autocorrelation. Although Durbin's h statistic proved to be significant, Durbin's h test failed to reject the hypothesis of no autocorrelation. Since these two tests yielded inconsistent conclusions, it was assumed that autocorrelation was not present in the model. Durbin's h test is generally considered to be a more preferred procedure in that it is intuitively more plausible and does not suffer from the indeterminacy that may be encountered in using the h test (Pindyck dan Rubinfeld, 2000).

As expected, price, lagged planted area, and trend had positive impacts on planted rice area (Farooq *et al*., 2001; Hazell, 1982). The estimated price coefficient suggests that a one rupiah per kg, increase in the supply-inducing price of rice, adjusted for inflation, would increase total Jambi planted area by 25.610 hectare. The coefficient for lagged planted area, representing the partial adjustment of producers' planting decisions from one year to the next, was positive and less than one and statistically significant at the 1and 5-percent levels. Total Jambi rice area exhibited a positive trend of about 18.580 hectares per year over the 1986-2013. Production costs had negative impacts on planted area. The estimated coefficient for production costs suggests that an increase in variable cash expenses of one per hectare, adjusted for inflation, would decrease total Jambi planted area by 9.670 hectares.

Elasticity estimates for price and production costs from the OLS regression model of Jambi rice area are shown in Table 2. Short-run price elasticity was estimated to be .28 at the sample mean .16 in 2013. These estimates were found to be within the range of price elasticity estimates from previous studies. Long-run elasticity were estimated by dividing the short-run elasticity by (1-α_2), where α_2 is the estimated coefficient for the lagged planted rice area in equation (2). With this estimates of .71 and .41 at the sample mean and in 2013, respectively, area response to changes in the supply-inducing price of rice was inelastic in the long-run at the regional level.

Table 1. Response Model of Jambi Rice Area, 1986-2013

Variable	Coefficient	Std. Error
Intercept	-12.57	
	(-.09)	
PS_t	25.61	8.954
	(2.86)[b]	
A_{t-1}	.61	0.184
	(3.32)[a]	
$ECOP_t$	-9.67	3.109
	(-3.11)[a]	
T_t	18.58	6.781
	(2.74)[b]	
Adj. R^2	.74	
F-statistic	9.42	
Durbin's h-statistic	-1.83	

Number in parenthesis is t-statistics
[a]Significant at the 0.01 level
[b]Significant at the 0.05 level

Table 2. Jambi Rice Price and Production Cost Elasticity

Elasticity	Short-run	Long-run
Price		
Mean	.28	.71
2008	.16	.41
Production Cost		
Mean	-.68	-1.74
2008	-.61	-1.56

Table 3. SUR Regional Rice Area Response Model, 1986-2013

Variable	Kerinci	Batanghari	Tanjab Timur
Intercept	-248,89	123,76	-103,17
	(-2.36)[b]	(1.34)	(.97)
PS_t	19,85	17,63	18,06
	(2,65)[b]	(2,48)[b]	(2,58)[b]
A_{t-1}	.58	.31	.42
	(5,93)[a]	(2,93)[b]	(3,81)[a]
$ECOP_t$	-5,96	-5,06	-4,87
	(-2,51)[b]	(-2,39)[b]	(-2,48)[b]
T_t	14,28	8,72	11,89
	(2,51)[b]	(1,72)	(2,46)[b]

Number in parentheses is t-statistics
[a]Significant at the 0.01 level

Table 4. Ratio of SUR to OLS Standard Errors

Variable	Kerinci	Batanghari	Tanjab Timur
Intercept	0,76	0,66	0,76
PS_t	0,83	0,79	0,78
A_{t-1}	0,53	0,57	0,59
$ECOP_t$	0,76	0,68	0,63
T_t	0,84	0,75	0,71

The estimated short-run production cost elasticity of Jambi rice area was also found to the inelastic. However, with estimates of .68 at the sample mean and .61 for 2013, the magnitude of those elasticity are about 3 or four times greater than that of the price elasticity, indicating that planting decisions have been more responsive to changes in production costs than to changes in price. F-tests conducted to test for equal proportional response to changes in price and production costs showed that these two responses were statistically different at the 10-percent significance level in the short-run at both the sample mean and for 2013. Long-run production cost elasticity were found to be elastic with estimates larger than -1.50.

Under the assumption of the classical multiple linear regression model, OLS estimations of the regression coefficients are unbiased and efficient. This assumes that the specified model represents all there is to know about the regression equation and the variables involved. However, in estimating a set of similar equations, such as the commodity area response equations for various regions estimated in this study, the error terms from one equations are often found to be correlated with the error terms in another equation. Failure to account for this cross-equation, contemporaneous correlation in estimating a set of equation could invalidate the properties of the OLS estimation. Therefore, the four regional equations were estimated as a set through the use of seemingly unrelated regression (SUR), a procedure first proposed by Zellner (Zellner, 1982) which takes cross-equation correlation into account.

Results from the SUR estimation of the regional area response equation are shown in Table 3. Estimated coefficients for the price variable were positive in sign and statistically significant in two of three regions. Production cost coefficients were negative in sign and statistically significance in all regions. Production cost coefficients were negative in sign and statistically significant in all regions. Ratios of standard errors given in Table 4 indicate that at least some gain in efficiency in the estimation of all variables in the model was achieved by the use of SUR over OLS for this particular model.

The greatest gains in efficiency were achieved in the estimation of the production cost parameter, while relatively minor gains were achieved in the estimation of the price parameter. Although Durbin's h test indicated possible autocorrelation in two of the three regional equations when estimated by OLS. Durbin's m test failed to reject the hypothesis of no autocorrelation in each equations at the 5-percent significance level. Therefore, no transformation of the data to correct for autocorrelation was performed prior to SUR estimation.

4. Conclusion

This study analyzed the impact of changes in rice prices and production costs on Jambi rice planted area over the 1986-2013 period. Supply-inducing prices of rice were estimated as a function of effective rice support prices and seasonal average market prices. Expected production costs per hectare were estimated using lagged actual total variable cash production expenses per hectare multiplied by the previous 3-year average annual percentage change in variable expenses. Other explanatory estimated at Jambi response equations were variables included in the model were lagged planted area, and trend. Area response equations were estimated at Jambi level as well as at the regional level. Estimated short-run price and production cost elasticity were found to be inelastic at the regional level. However, the magnitude of the production cost elasticity was about 3 times greater than the price elasticity. Estimated long-run elasticity at Jambi level was inelastic for changes in price but elastic for changes in production costs. Similar relationships were found at the regional level. The three estimated regional area equations estimated by seemingly unrelated regressions yielded short-run production cost elasticity which were 2 to 3 times greater in magnitude than the estimated price elasticity.

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